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MOST USER'S GUIDE

Volume II

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Selection	Damage	Elements
LAIR	Targeting	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

MOST is a computer program (for Multiweapon Optimizer for Strategic Targets) which finds the fewest number of nuclear weapons necessary to attack a complex of targets. This is a user's guide to the code.

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PREFACE

This report is a User's Guide to the MOST code (for Multiweapon Optimizer for Strategic Targets), written for the Joint Strategic Target Planning Staff by Science Applications, Inc. under the sponsorship of the Defense Nuclear Agency.

As MOST, in its current form, is a set of subprograms rather than an independent program, this document addresses itself to how a user can yoke the MOST subprograms to his own driver routines. Detailed information concerning the methodology is available in the MOST Final Report, to be published separately.

For further information, please write to

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INTRODUCTION

MOST (for the Multiweapon Optimizer for Strategic Targets) is a set of FORTRAN subprograms designed to determine the fewest number of aimpoints (and, consequently, nuclear bursts) needed to attack airfields and simultaneously satisfy complex success requirements. Although the methodology can support numerous variations and extensions (see the MOST Final Report), MOST is tailored to the needs of one probably atypical user. Others should bear this specialization in mind while evaluating the potential usefulness of MOST to them.

Because MOST is not a stand-alone code this guide addresses itself to the narrow range of how MOST, as it now exists, is made to become part of larger programs. It therefore assumes on the part of the reader a familiarity with the MOST methodology and the terminology of aimpoint selection appropriate to it.

1. CALLING PARAMETERS

The 51 subprograms comprising MOST fit in 21K words on the DEC KL-10 computer. MOST is entered via a call to subroutine MOST, which has ten parameters. Table 1 lists the ten parameters and describes their meanings. Most of these require no further description. The three that do are LVLD, LOWER, and FLOOR.

LVLD controls the line-printer output produced. If LVLD is set to zero, none is produced. Set to one, a report is produced that shows each DGZ selected, the damage each produces, an indication of which installations are objective, and the damages when compounded. Set to higher values LVLD adds debugging print to the report and performs certain internal consistency checks. Eleven levels are currently implemented (0, 1, 2, 3, 5, 6, 7, 20, 21, 51, 61).

LOWER is a logical flag which, if set to .TRUE., causes MOST to see if solutions involving fewer weapons than the regular solution may nevertheless satisfy the various requirements due to the compounding of probabilities. The PD requirement for critical targets is lowered to that of support elements for solutions involving more than two weapons. If no fewer-weapon solutions are found, the results will have traded off a higher APD on the complex for somewhat lower PD's on some critical targets. If a solution involving fewer weapons is returned, then the actions are more complex. If the solution has one fewer weapon and does not meet the APD requirement, then the original solution is the final solution. If it does meet the APD requirement, then it becomes the final solution.

If more than one weapon is dropped from the original solution and the APD is acceptable, the new solution becomes the final solution. However, if it does not meet the APD requirements, the interval between PDC and PDS is searched for a solution

Table 1. MOST Calling Parameters

Parameter	Type	Meaning
PDC	REAL	Required probability of damage for critical targets. (0.<PDC<1.)
PDS	REAL	Required PD for support elements. (0.<PDS<1.)
APD	REAL	Value-weighted average PD for target complexes (airfields). (0.<APD<1.)
YIELD	REAL	Weapon yield in kilotons
CEP	REAL	Miss distribution in feet
HOB	REAL	Actual height-of-burst in feet
LVLD	INTEGER	Level of debug processing desired. (0≤LVLD)
IWEAP	STRING	Two-character weapon identifier (2Hxx)
LOWER	LOGICAL	.TRUE. → compounded aimpoint optimization to be used.
FLOOR	REAL	Lowest compounded PD allowed on critical target. (0.<FLOOR<1.)

involving an additional weapon but still fewer than required by the original solution. The process increases PDC from PDS. It terminates when an acceptable solution is found, or no solution is found.

FLOOR is a qualifier to the above procedure, adding an additional acceptability requirement on the critical target compounded PDs. No solution is acceptable if the compound PD is less for any critical element than the floor value. Therefore, PDS $\leq$ FLOOR $\leq$ PDC is a reasonable range. Setting PDS equal to FLOOR cancels the effect of this parameter.

2. DATA BASE

MOST expects to find its data in common INSTS. The driver constructed by the user must place the installation data in this common prior to calling MOST. The common consists of three simple variables and an array:

Variable	Dimension	Use
NTARGS	-	Number of installations making up the basic DGZ or unit of processing
TDATA	(32,100)	Array containing installation data
ISLE		JSTPS target island number
IDGZ		Basic DGZ identifier

Table 2 shows the structure of the TDATA array, which is frequently equivalenced to IDATA (32,100) for referencing integral values or character strings. There is one installation per each second subscript. Therefore, MOST can store data for up to 100 installations at one time. The values below the dashed line are calculated by MOST.

The FLAG, in position 21, divides the installations into six categories, of which only four are currently used:

Category	Description
1	Critical target whose PD may be lowered
2	Support target
3	Non-target
4	Critical target whose PD requirement is strict

Installations of category four require strict adherence to the PDC requirement, while those of category one can be reduced as described above.

Table 2. Structure of Inspection Data

TDATA(N,...)	MEANING	FORM
1	ISLE number	Integer
2	DGZ indicator	3 characters
3	TDI category	Integer
4	TIDE code	1 character
5		
6	WAC-BE	12 characters
7		
8	Element indicator	1 character
9	ARK code	1 character
10		
11	Place name	12 characters
12		
13	LATITUDE (DDMMSS)	Integer
14	"N" or "S"	1 character
15	LONGITUDE (DDDMMSS)	Integer
16	"E" or "W"	1 character
17	VNTK (VNTKK)	Integer
18	VN flag	1 character
19	R95 in nautical miles	Real
20	Value	Integer
21	FLAG	Integer
22	Kill requirement	Real
23	Weapon radius in feet	Real
24	DAMAGE SIGMA	Real
25	LAIR in feet	Real
26	X coordinate in feet (longitude)	Real
27	Y coordinate in feet (latitude)	Real
28	Unused	-
29	Probability of survival	Real
30	Unused	-
31	Unused	-
32	Unused	-

All character strings are in Hollerith format with no more than four per word.

VNTK numbers are encoded as three integers packed into one word. The VN number, the K portion and the T portion are stored as two digit integers. For the T portion, there is a correspondence between the alphabet and the numbers one through twenty-six. Thus VN-TT-KK is the form of the six-digit code.

The DGZ field (position 2) is generated by MOST to reflect installation objectivity.

3. FILES/RESULTS

There are three files used by MOST. File code one is an EBCDIC/BCD output file to contain the line-printer output, if specified, including any possible error messages. File code two is a binary scratch file used by MOST to store a solution while looking for a solution of fewer weapons due to compounding.

File code 15 contains the results of the aimpoint selection. There are three kinds of records in the file: installation records, DGZ records, the PD records. The formats for all three are shown in Table 3. Each DGZ found is preceded by installation records for the installations objective to the DGZ. The set of DGZ records is followed by a PD record which contains the value-weighted average PD of the airfield involved due to all DGZs. All three record types are 80 characters in length.

Table 3. Output file format

INSTALLATION RECORD:

```
00000 000 01111 1 111112222222 2 2 233333333334 444444 4 4455555 5 55556 6666 66666 7 777 7777778
12345 678 90123 4 567890123456 7 8 901234567890 123456 7 8901234 5 67890 1234 56789 0 123 4567890

99999|AAA|99999|A|AAAAAAAAAAAA|A|A|AAAAAAAAAAAA|999999|A|9999999|A|99A99|9.99|99999|2|999|ƀƀƀƀƀƀƀ
                 T              L A                                                     F
                 I              L R                                                     L
ISLE  DGZ TDICAT D    WAC-BE    K K    PLACE     LATITUDE  LONGITUDE  VN   R95  VALUE   A  PD NOT USED
                                M                                                       G
```

DGZ RECORD:

```
99999|WAƀ| ———————————————— ƀ|999999|A|9999999|A|ƀ ——————— ƀ|Ø|999|ƀ —— ƀ
                                                            F
                                                            L
ISLE   DGZ                                                  A  PD
                                                            G
```

PD RECORD:

```
99999|AAA|ƀ ———————————————— 000000|N|0000000|N|ƀ ——————— ƀ|1|999|ƀ —— ƀ
                                                           F
                                                           L
ISLE   DGZ                                                 A  PD
                                                           G
```

4. SUBROUTINES INITIA AND BDATA

Subroutine INITIA initializes two common blocks (CNSTS and OPTIM), and can, if desired, open various files used by the program. INITIA must be called prior to calling MOST. Various constants whose values should be computed to as high an accuracy as possible are assigned values here, as well as constants used so frequently that a single calculation of their values saves significant run time. The details of this routine will vary from machine to machine.

There is one BLOCK DATA subprogram (named BDATA on machines which allow naming of such subprograms). It must be explicitly loaded.

5. DAMAGE CALCULATIONS

The subprograms which calculate such quantities as PD, offset, weapon radius, and sigma have been extracted from DCAPS 3.0. They are, therefore, based on release 2 of PDCALC, DIA's WPNRAD, and some SAI-developed models. The routines are common to DCAPS, WEPROE, IDES, TANDEM, and CIVIC and can, therefore, be assumed to be calculating their results in a more-or-less official way. A detailed description of the inner workings of the damage routines will be published as part of the detailed DCAPS documentation due August, 1978.

APPENDIX A

MOST ROUTINES AND LINKAGE

ROUTINE	CALLS	CALLED BY
ADD	-	BEGIN
ADDLNK	-	MARK, REDUCE
ADDONE	PDCMP	MOST
AIMPRT	-	REDUCE, SELECT
BEGIN	ADD, MPY2, PTS	LEAST
CHORD	-	PTS
CIRCOV	ERF	CLNPOD
CLNPOD	CIRCOV	OFFSET, PODCOV
CTRAN1	-	RECORD, REPORT
CTRAN2	-	STPRNT, REPORT
DOWN	LEAST, RLAIR, RSTORE, SAVE	MOST
ENOUGH	-	MIN
ERF	-	CIRCOV
GETRPS	-	LEAST
ICNV2	-	SETUP
ICNV3	-	PRNTL, REPORT, PDTOTS
INITIA	-	DRIVER
INLINK	-	MARK
INSRT2	-	MPY2
LEAST	BEGIN, GETRPS, MARK, OPTMZ, PRNTL, REDUCE, SELECT STPRNT	DOWN, MOST
MARK	ADDLNK, INLINK	LEAST
MIN	ENOUGH, NEED1, POP, PUSH, STUFFA, USED	REDUCE
MOST	ADDONE, DOWN, LEAST, OPTMZ, REPORT, SETUP	DRIVER
MPY2	INSTR2	BEGIN
NEEDL	US2	MIN
OFFSET	CLNPOD	RLAIR

ROUTINE	CALLS	CALLED BY
OPTMZ	PD, PDCMP, PDTOTS	LEAST, MOST
PD	PODCOV	OPTMZ, PDCMP, PDTOTS
PDCMP	PD	ADDONE, OPTMZ
PDTOTS	ICNV3, PD	OPTMZ, REPORT, SELECT
PODCOV	CLNPOD	PD
POP	-	MIN
PRNT1	ICNV3	LEAST
PTS	CHORD	BEGIN
PUSH	-	MIN
PVWRSG	-	WRSIG
RECORD	CTRAN1	SETUP
REDUCE	ADDLNK, AIMPRT, MIN, ST2PR, STUFFA	LEAST
REPORT	CTRAN1, CTRAN2, ICNV3, PDTOTS	MOAR
RLAIR	OFFSET	DOWN, SETUP
RPAVG	-	SETUP
RSTORE	-	DOWN
SAVE	-	DOWN
SELECT	AIMPRT, PDTOTS	LEAST
SETUP	ICNV2, RECORD, RLAIR, RPAVG, WRSIG	MOST
ST2PR	-	REDUCE
STPRNT	CTRAN2	LEAST
STUFFA	-	MIN, REDUCE
US2	-	NEEDL1, USED
USED	US2	MIN
VNWRSG	-	WRSIG
WRSIG	PVWRSG, VNWRSG	SETUP

APPENDIX B

NAMED COMMON AND VARIABLES

COMMON	VARIABLES	LENGTH
ACCU	ACC	1
AIMPT2	LIMPTS, XP(2,200), YP(2,200), LPTS2	802
CNSTS	PI, TWOPI, THRD, T2L2, ALG10, T2L20, SQT2L2, FTNM, IALPH(36), DIGITS(10), DEGRAD, SQT2, RT2OPI	59
DEBUG	LVLD	1
INSTS	NTARGS, TDATA(32,100), ISLE, IDGZ	3203
LINK	LINKC(100), NLINKS	101
MODES	MODEL	1
OBJ	ITEM	1
OPTIM	FUDGE	1
ORIGN	ALATX, ALONX, COSLAT	6
RPS	RPX(250), RPY(250)	500
STACK	ISTACK(3,250), IPT, ISPACE(2,1500), IAVAIL	3752
STACK2	IST2(5,100), MARK2(500), LIMST2, NGRPS	1002
TOTS	AIRPRT, VALAIR	2
UNITS	INCMD, IOUTTY, IOUTLP, INSTAL, ITMPFL, ITMPF2,ENDF	7
USEDL	USTK(3,100), NAMES(100), NNAMES, COUNT	402
	TOTAL:	9841

APPENDIX C

COMMON VARIABLES ALPHABETICALLY

VARIABLE	COMMON	VARIABLE	COMMON
ACC	ACCU	MARK2(500)	STACK2
AIRPRT	TOTS	MODEL	MODES
ALATX	ORIGN	NAMES(100)	USEDL
ALGLØ	CNSTS	NGRPS	STACK2
ALONX	ORIGN	NLINKS	LINK
COSLAT	ORIGN	NNAMES	USEDL
COUNT	USEDL	NTARGS	INSTS
DEGRAD	CNSTS	PI	CNSTS
DIGITS(10)	DNSTS	RPX(250)	RPS
ENDF	UNITS	RPY(250)	RPS
FTNM	CNSTS	RT2OPI	CNSTS
FUDGE	OPTIM	SQT2	CNSTS
IALPH(36)	CNSTS	SQT2L2	CNSTS
IAVAIL	STACK	T2L2	CNSTS
IDGZ	INSTS	T2L2Ø	CNSTS
INCMD	UNITS	TDATA(32,100)	INSTS
INSTAL	UNITS	THRD	CNSTS
IOUTLP	UNITS	TWOPI	CNSTS
IOUTTY	UNITS	USTK(3,100)	USEDL
IPT	STACK	VALAIR	TOTS
ISLE	INSTS	XP(2,200)	AIMPT2
ISPACE(2,1500)	STACK	YP(2,200)	AIMPT2
IST2(5,100)	STACK2		
ISTACK(3,250)	STACK		
ITEM	OBJ		
ITMPFL	UNITS		
ITMPF2	UNITS		
LIMPTS	AIMPT2		
LIMST2	STACK2		
LINKC(100)	LINK		
LPTS2	AIMPT2		
LVLD	DEBUG		

APPENDIX D

MOST SUBROUTINES AND THEIR COMMONS

ADD
STACK

ADDLNK
LINK
STACK

ADDONE
INSTS
RPS
STACK
STACK2
TOTS

AIMPRT
STACK
UNITS

BDATA
ACCU
CNSTS
UNITS

BEGIN
INSTS
STACK
UNITS

CIRCOV
CNSTS
UNITS

CLNPOD
CNSTS
UNITS

CTRAN1
ORIGN

CTRAN
ORIGN

DOWN
DEBUG
INSTS
UNITS

ENOUGH
INSTS
STACK2
USEDL

GETRPS
AIMPT2
INSTS
RPS
STACK

ICNV2
CNSTS

ICNV3
CNSTS
INSTS

INLINK
LINK
STACK

INSRT2
STACK

LEAST
DEBUG
UNITS

MARK
INSTS
LINK
STACK
STACK2

MIN
DEBUG
MODES
STACK2
UNITS
USEDL

MOST
DEBUG
UNITS

MPY2
AIMPT2
INSTS
OPTIM
STACK

NEEDL
STACK2

OFFSET
ACCU

OPTMZ
DEBUG
INSTS
RP
STACK
STACK2
TOTS
UNITS

PD
INSTS

PDCMP
INSTS
TOTS

PDTOTS
INSTS
OBJ
UNITS

PODCOV
CNSTS

POP
USEDL

PRNT1
DEBUG
INSTS
UNITS

PTS
AIMPT2
DEBUG
INSTS
STACK
UNITS

PUSH
STACK
STACK2
USEDL

RPAUG
INSTS
ORIGN

REDUCE
DEBUG
LINK
STACK
STACK2
UNITS

REPORT
DEBUG
INSTS
OBJ
RPS
STACK
STACK2
TOTS
UNITS

RLAIR
CNSTS

RPAVG
INSTS

APPENDIX D (continued)

RSTORE

AIMPT2
INSTS
LINK
RPS
STACK
STACK2
UNITS
USEDL

SAVE

AIMPT2
INSTS
LINK
RPS
STACK
STACK2
UNITS
USEDL

SELECT

DEBUG
INSTS
RPS
STACK
STACK2
TOTS
UNITS

SETUP

DEBUG
INSTS
UNITS

ST2PR

STACK2
UNITS

STPRNT

DEBUG
RPS
STACK
STACK2
UNITS

STUFFA

STACK
STACK2

US2

USEDL

USED

STACK
STACK2

VNWRSG

UNITS

WRSIG

UNITS

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